Quantitative Assessment of Magnetic Field Models

1. Global MHD code and Tsyganenko Models
2. Magnetospheric configuration and ULF wave fields
3. Applications

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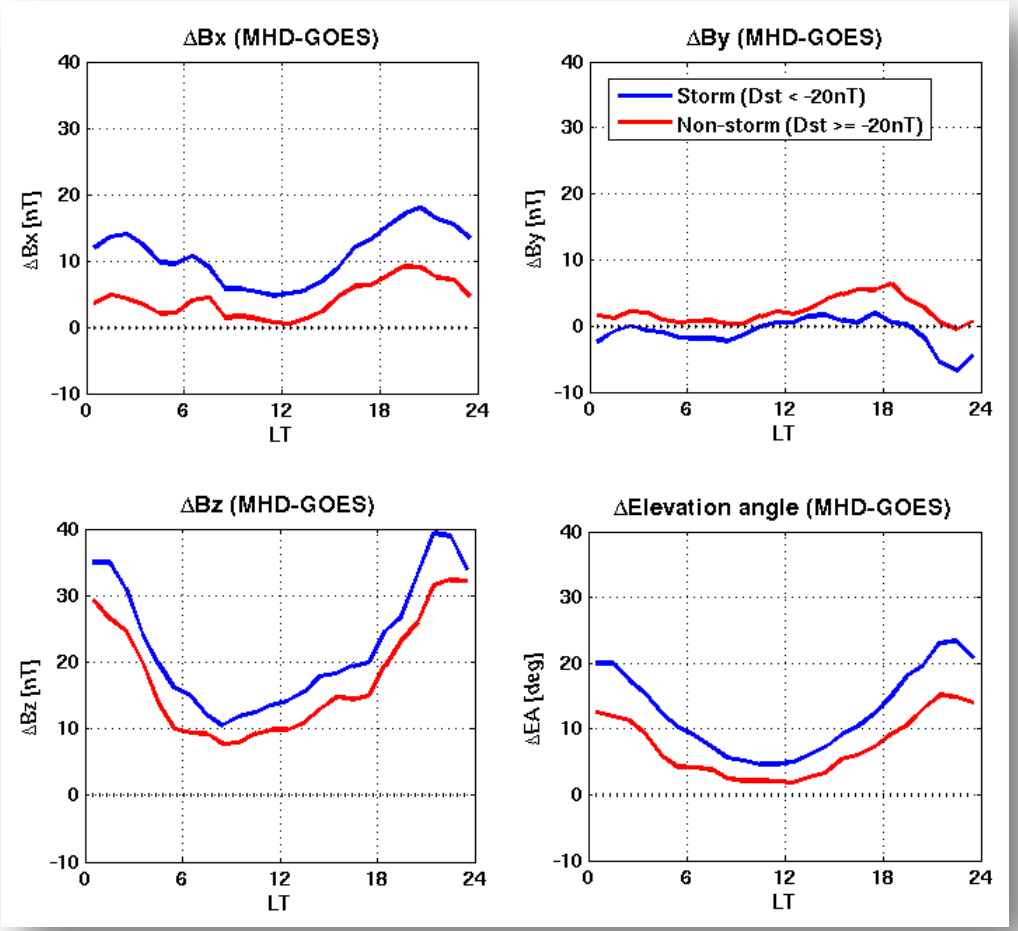
Magnetic Fields From Global MHD Code

- Lyon-Fedder-Mobarry MHD code
  - B-field predictions at GEO: 9 storms and a 2-month non-storm interval
  - Field lines are under-stretched, especially during storm-time, on the nightside
  - Predict reasonable non-storm time field
- For better result: high resolution & couple with RCM

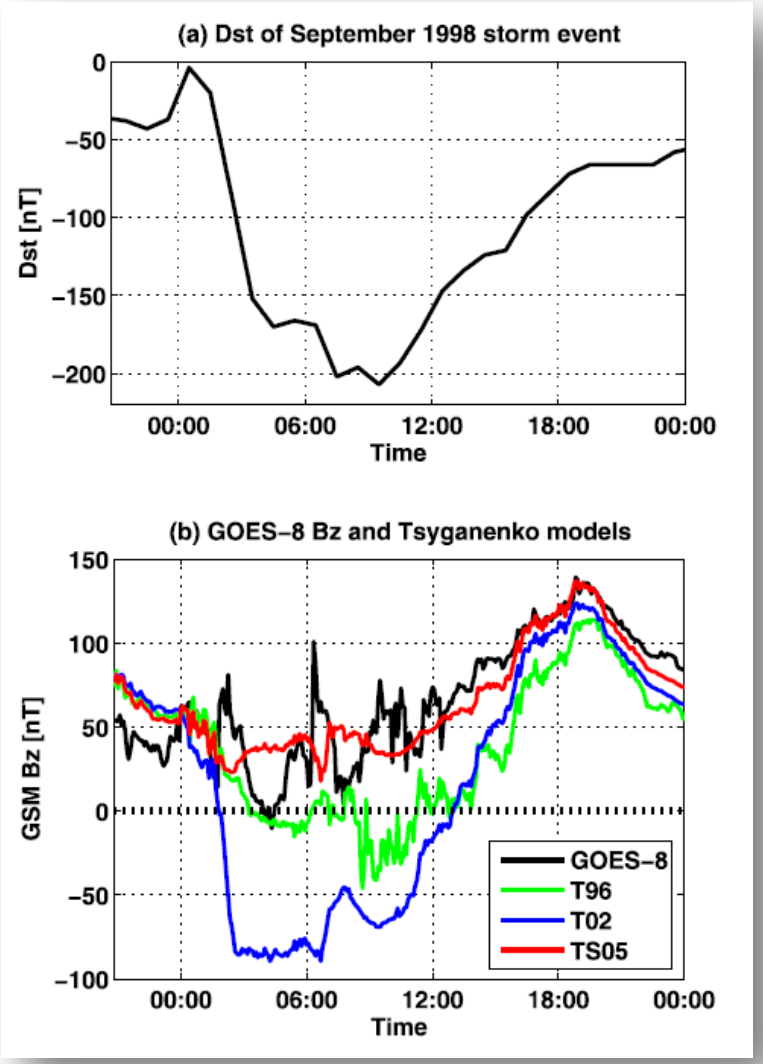
Residual field $\Delta B = B_{MHD} - B_{GOES}$



Huang et al. [2006]

Magnetic Fields From Tsyganenko Models

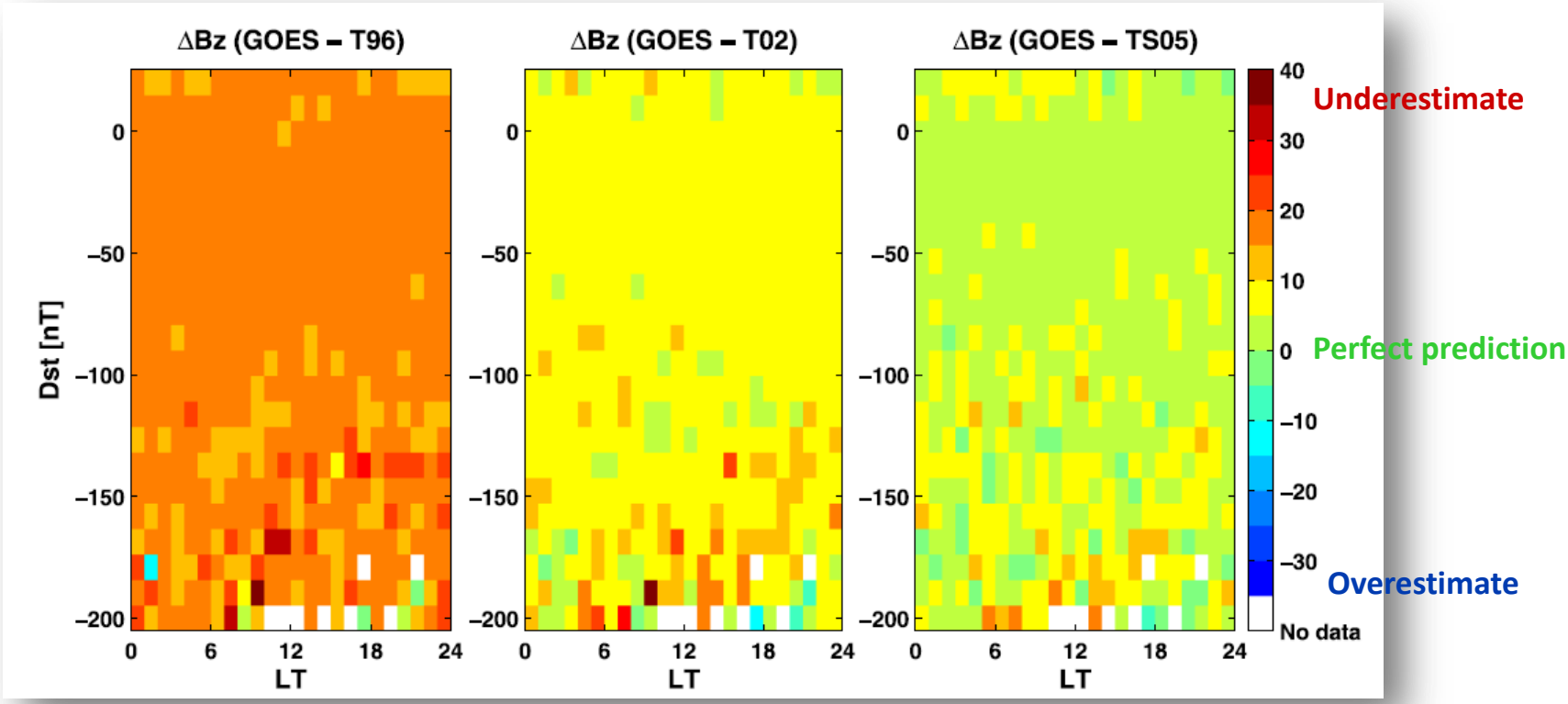
- Tsyganenko models
  - Global, parameterized, quasi-static states of Earth's magnetosphere
- Inputs:
  - Pdyn, Dst, IMF By and Bz
  - Parameters represent the SW time-integrating effect
- Field sources:
  - $B_{CF} + B_{SRC} + B_{TC} + B_{FAC} + B_{INT}$ and B_{PRC}
- Different datasets and calculation methods



Statistical Analysis of Tsyganenko Models I

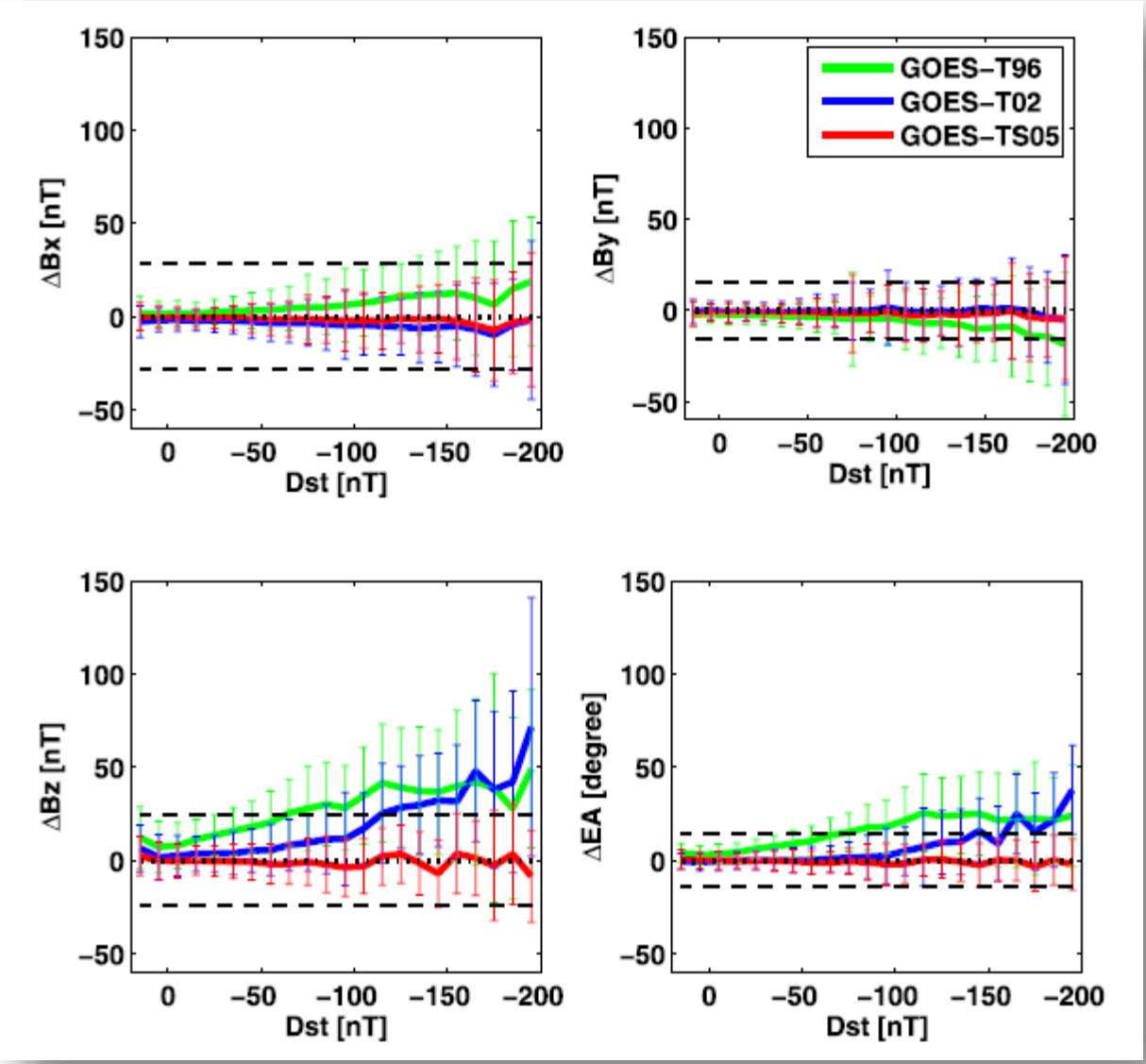
- Model/Data comparisons at geosynchronous orbit
  - 52 major storms (Dst < -100 nT) from 1996 to 2004 (1.5 x 10^5 5-min data points)

Residual field $\Delta B = B_{GOES} - B_{Tmodel}$



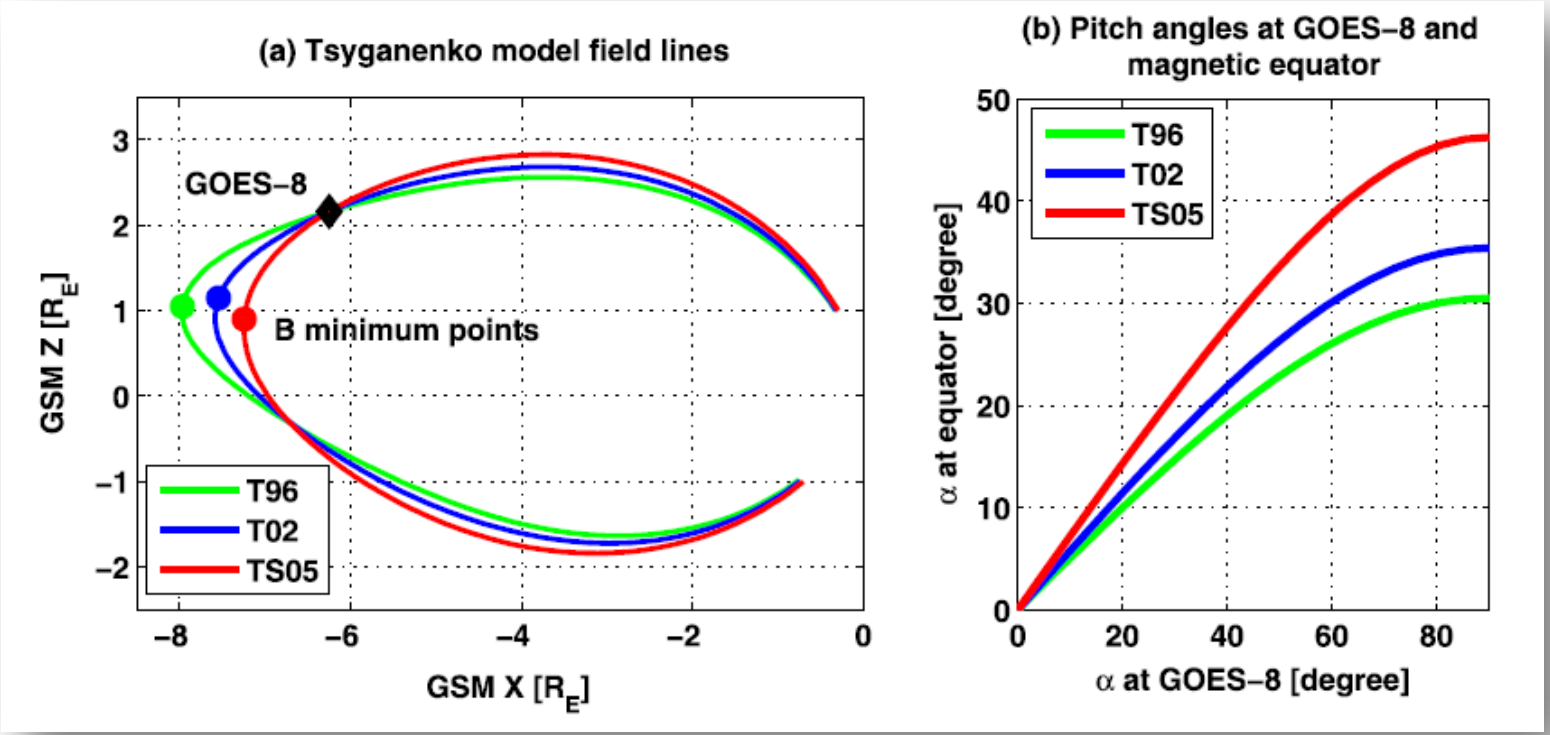
Huang et al. [2008]

Statistical Analysis of Tsyganenko Models II

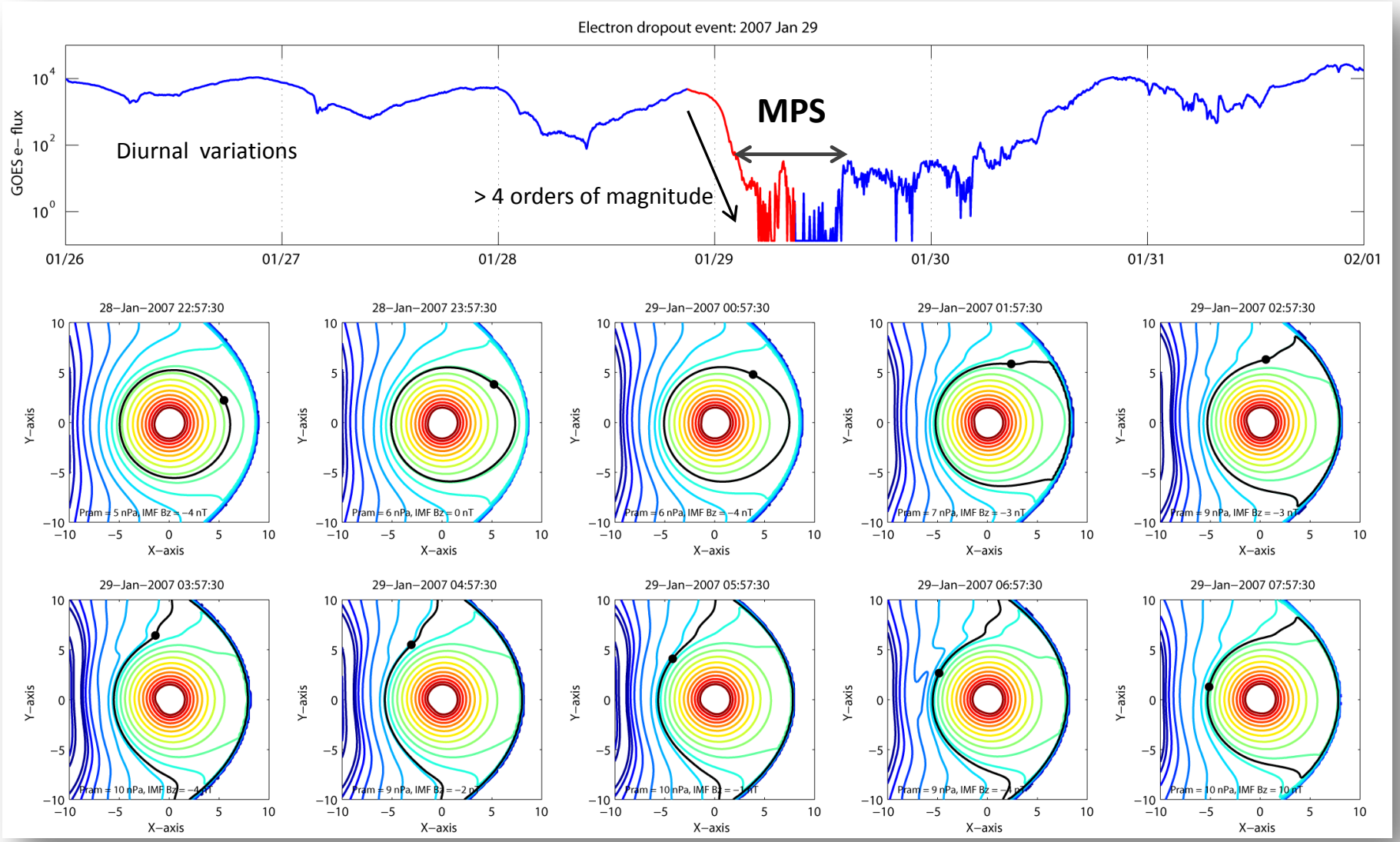


Consequences of Field Model Errors

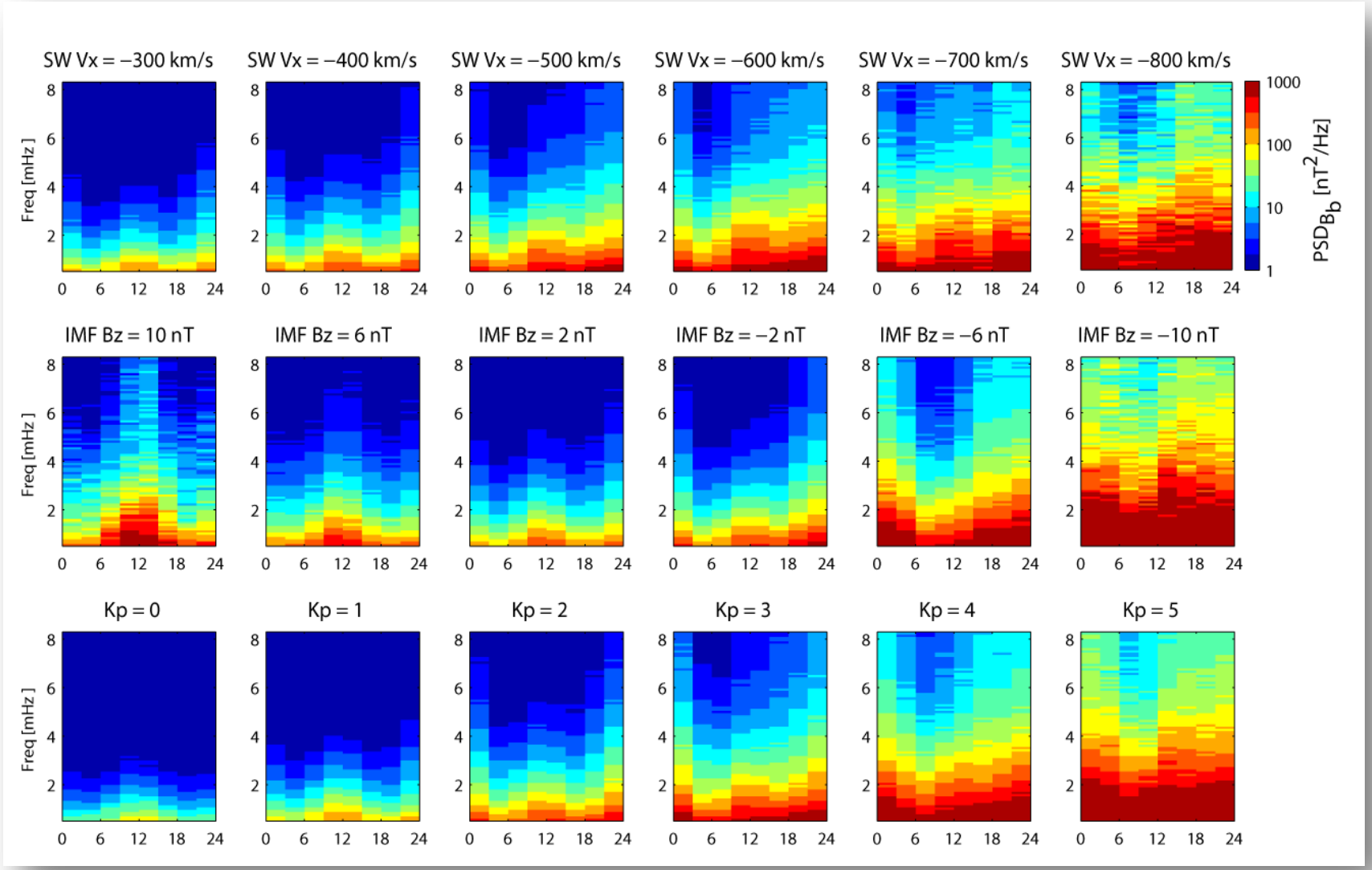
- Inaccurate B-field model could alter the results of related studies
- Discrepancies between T models using same inputs (Pd = 3 nPa, Bz = +5 nT)
  - 15% error in L* calculation between T96 and TS05



Using TS05 Model to Find MPS Signature

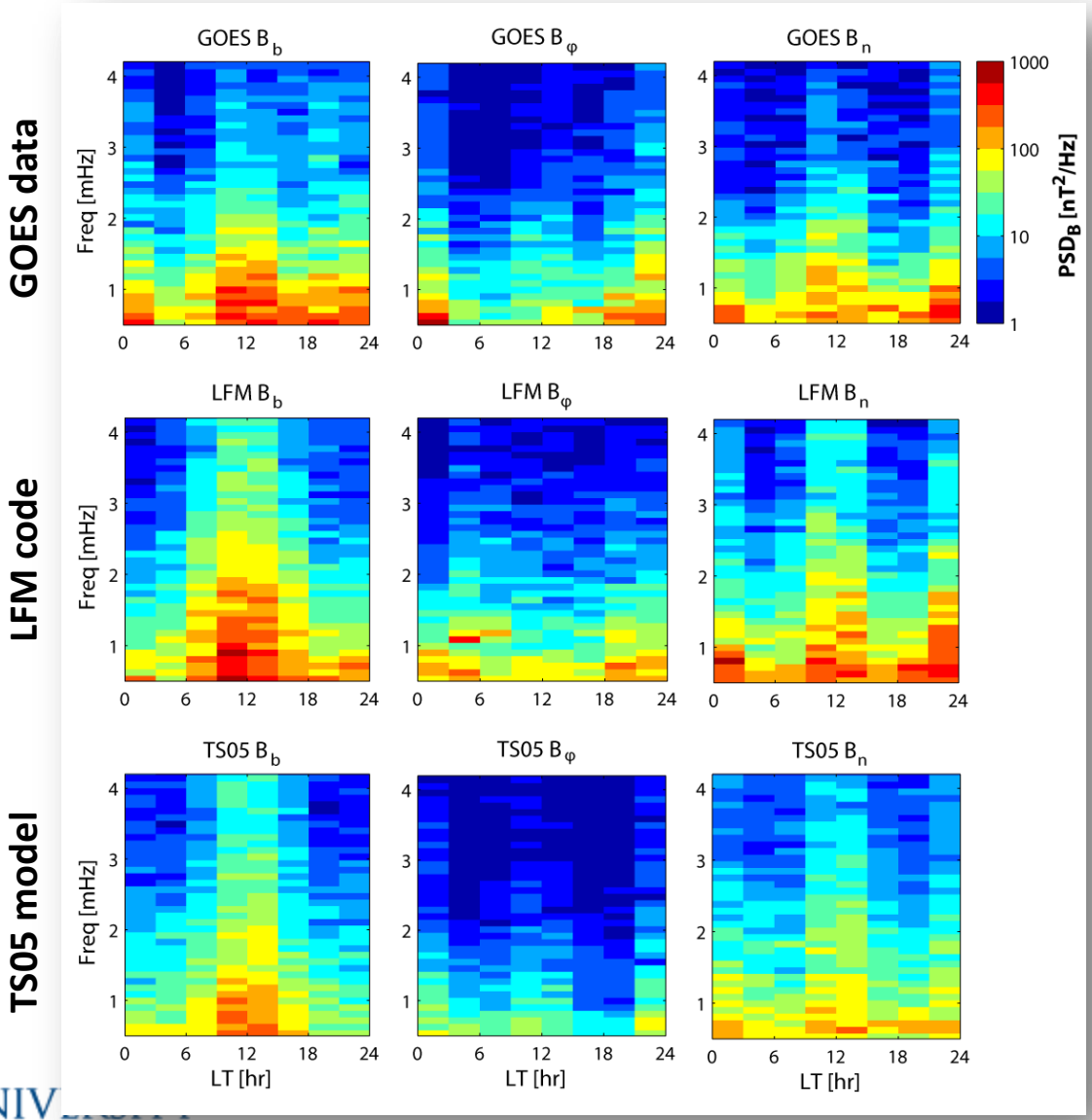


GOES ULF wave power: B_b (Vx, Bz, Kp)



Huang et al. [2010]

ULF Wave Powers of GOES, LFM &TS05



- Feb-Apr 1996: typical solar wind condition
- **LFM** wave prediction is reasonable
- **TS05** underestimates wave power

Summary

Model	Storm time B	Non-storm time B	ULF wave field
Tsyganenko Model	☺	☺	X
LFM MHD code	X	☺	☺

- **More application:** use LFM's wave fields during non-storm time to study radial diffusion of radiation belt electrons

- **Future work:** Tsyganenko and Sitnov 2007 model